

CLAIMS

What is claimed is:

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1. A method of making olefins, comprising contacting an oxygenate feed with at least two different zeolite catalysts to form an olefin composition.

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2. The method of claim 1, wherein the oxygenate feed contains at least 70 wt.% oxygenate.

3. The method of claim 1, wherein the oxygenate feed contains at least 80 wt.% oxygenate.

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4. The method of claim 1, wherein the oxygenate feed contains at least 90 wt.% oxygenate.

5. The method of claim 1, wherein at least one of the zeolite catalysts contains a ZSM-5 molecular sieve.

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6. The method of claim 5, wherein the ZSM-5 molecular sieve is selected from the group consisting an unmodified ZSM-5, a phosphorous modified ZSM-5, a steam modified ZSM-5 having a micropore volume reduced to not less than 50% of that of the unsteamed ZSM-5, and mixtures thereof.

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7. The method of claim 1, wherein at least one of the zeolite catalysts contains a 10-ring zeolite molecular sieve.

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8. The method of claim 1, wherein at least one of the zeolite catalyst contains a zeolite molecular sieve selected from the group consisting of ZSM-22, ZSM-23, ZSM-35, ZSM-48, and mixtures thereof.

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9. The method of claim 1, wherein at least one of the zeolite catalysts contains one of the zeolite molecular sieve selected from the group consisting of ZSM-22, ZSM-35, and mixtures thereof.

5 10. The method of claim 1, wherein at least one of the zeolite catalysts contains a ZSM-35 molecular sieve.

10 11. The method of claim 1, wherein the zeolite catalysts comprise a zeolite catalyst containing a ZSM-5 molecular sieve and a zeolite catalyst containing a ZSM-22 or a ZSM-35 molecular sieve.

15 12. The method of claim 1 or 11, wherein the oxygenate feed is contacted with the zeolite catalysts mixed together in one reactor.

20 13. The method of claim 1 or 11, wherein the oxygenate feed is contacted with the zeolite catalysts in a first bed containing a first catalyst containing ZSM-5 molecular sieve and a second bed containing a second zeolite catalyst containing molecular sieve selected from the group consisting of ZSM-22, ZSM-35, and mixtures thereof.

25 14. The method of claim 1 or 11, wherein the oxygenate feed is contacted with the zeolite catalysts in separate reactors in series.

30 15. A method of making an olefin composition comprising:
contacting an oxygenate with a first zeolite catalyst to form an olefin product;
separating a butylene containing stream from the olefin product;
and
contacting the butylene containing stream with a second zeolite catalyst to form a second olefin product.

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16. The method of claim 15, wherein the butylene containing stream contains at least 20 wt.% butylene.

17. The method of claim 16, wherein the butylene containing stream contains at least 40 wt.% butylene.

18. The method of claim 15, wherein the butylene containing stream contains at least 50 wt.% butylene.

19. The method of claim 15, wherein the first zeolite catalyst comprises a ZSM-5 molecular sieve.

20. The method of claim 19, wherein the ZSM-5 is selected from the group consisting of unmodified ZSM-5, a phosphorous modified ZSM-5, a steam modified ZSM-5 having a micropore volume reduced to not less than 50% of that of the unsteamed ZSM-5, and mixtures thereof.

21. The method of claim 15, wherein the second zeolite catalyst comprises a zeolite molecular sieve selected from the group consisting of ZSM-22, ZSM-35, or a mixture thereof.

22. The method of claim 21, wherein the first zeolite catalyst contains a ZSM-5 molecular sieve and the second zeolite catalyst contains ZSM-22 or ZSM-35 molecular sieve.

23. The method of claim 15 or 22, wherein the oxygenate is contacted with the first zeolite in a fluidized-bed or riser reactor.